Fracturing Olivine via Shrinkage Cracks: Evidence from Dynamic Microtomography

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Sequestering CO2 via mineral carbonation has generated lots of interests owing to the abundance of silicate rocks and the permanence of the carbonated solids. However, the usefulness of ultramafic rocks as carbon storage hinges on the feasibility of creating and maintaining reactive surface area. Using synchrotron based X-ray micro- and nano-tomography techniques, we measured the evolution of the 3-dimensional pore geometry of an olivine aggregate undergoing mineral carbonation. We demonstrate that fracturing of the host rock can be achieved during carbonation reactions without additional energy input. Shrinkage cracking is responsible for producing the cracks. The polygonal pattern associated with shrinkage cracks is more consistent with fracture patterns observed in silicate rocks that undergo natural weathering. This experimentally tested mechanism of reaction-induced fracturing has important implications in geological carbon sequestration research.